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A REVIEW OF THE CLARK FORK VERTEBRATE FAUNA

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INTRODUCTION

The Clark Fork fauna, hitherto regarded as the standard for one of the provincial ages of the North American Continental Tertiary (Wood *et al.*, 1941, p. 9 and plate I), is known from only one area in the Bighorn Basin of northwestern Wyoming. In contrast to other Paleocene faunas representing provincial ages, no Clarkforkian quarry or pocket has yet been discovered. Consequently, this fauna has never been as well characterized as others in the standard sequence, and the validity of this provincial age has not been very well substantiated. This paper reviews previous work on the fauna and discusses some associated problems. Conclusions are based on field observations, a re-evaluation of the described collections, inspection of the original field notes, and unpublished annual reports of the Department of Vertebrate Paleontology of the American Museum of Natural History.

Professor Glenn L. Jepsen suggested this problem as a senior thesis topic while I was an undergraduate at Princeton. His generosity in permitting me access to Princeton's valuable collection of Paleocene fossils is here gratefully recognized. Dr. Malcolm C. McKenna of the American Museum of Natural History most kindly made available for study the specimens upon which the original Clarkforkian faunal description was based; I have also profited from discussions with him. I am much obliged to Professors Bryan Patterson, George Gaylord Simpson, Albert Wood, and Dr. Leigh Van Valen for criticisms and suggestions concerning this manuscript. In addition I am grateful to Dr. Giles MacIntyre, who found the map used by Walter Granger in the Bighorn Basin during the field seasons of 1910 through 1912. A portion of this map is reproduced in Figure 2. The hospitality of the Churchill family of Powell, Wyoming, added considerably to the enjoyment of

doing field work during the summers of 1961 and 1962. I would also like to thank Mrs. Frances Wood and Miss Margo Hayes for typing the numerous revisions of this paper.

Financial assistance provided from the John Boyd Fund of Princeton University enabled me to spend the latter part of the summer of 1961 and the entire field season of 1962 in the Bighorn Basin, working in the type areas of the Clark Fork fauna. Support from the National Science Foundation training grant for evolutionary biology at Harvard University was helpful during the final stages of my research.

Abbreviations used in this paper are as follows: AMNH, American Museum of Natural History; PU, Princeton University; FMNH, Field Museum of Natural History; USNM, United States National Museum.

HISTORY OF STUDY

During the summers of 1910 through 1913, and again in 1916, field parties sponsored by the American Museum of Natural History conducted extensive investigations of the Tertiary sediments of the Bighorn Basin. Some of the results were published by Sinclair and Granger in 1912; of interest to the present study was the recognition of a new vertebrate fauna occurring near the top of the Fort Union.[1] Specimens comprising the fauna were obtained from three different localities whose approximate positions, determined from the following descriptions, are labelled A, B, and C on the accompanying map (Fig. 1). These areas were described (Sinclair and Granger, 1912, pp. 59-60) as being ". . . on the southwest slopes of McCulloch Peak . . . about a mile due east of the point where the Fort Union-Wasatch contact line crosses the Shoshone River, 245 feet stratigraphically below the contact with the red-banded beds [A]; on the north side of the Shoshone River in the bluffs opposite Ralston station [B]; to the northwest of Ralston on Big and Little Sand Coulee [C]." Only the McCulloch Peak locality (A) was regarded as being unquestionably Paleocene; some uncertainty was expressed concerning the exact stratigraphic position of the other two areas. This doubt led the authors to conclude ". . . we feel that further examination of the stratigraphy is desirable. Should the beds in question prove to be older than the Knight [early Eocene], and it be deemed advisable to give them a formation name, they may be referred to as the Ralston beds or Ralston formation."

[1] The Paleocene rocks in this area have been referred to as the Polecat Bench Formation; see Jepsen, 1940.

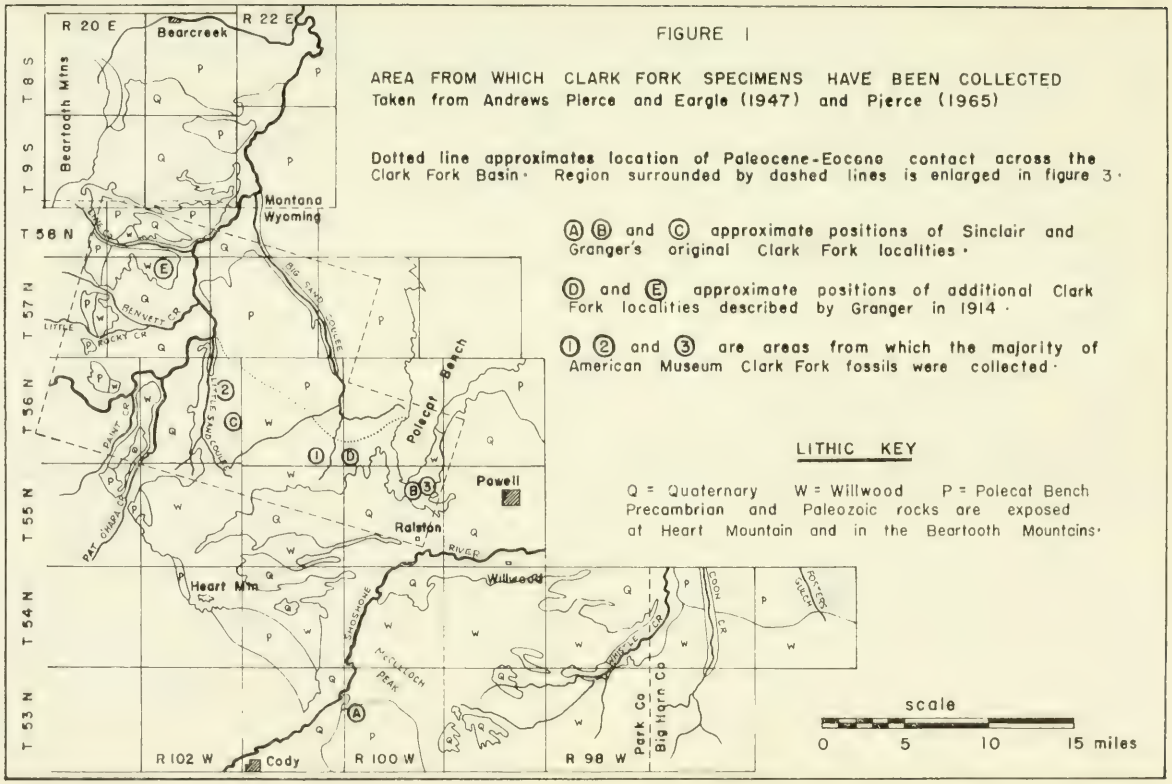

FIGURE 1

AREA FROM WHICH CLARK FORK SPECIMENS HAVE BEEN COLLECTED
Taken from Andrews Pierce and Eargle (1947) and Pierce (1965)

Dotted line approximates location of Paleocene-Eocene contact across the Clark Fork Basin. Region surrounded by dashed lines is enlarged in figure 3.

Ⓐ Ⓑ and Ⓒ approximate positions of Sinclair and Granger's original Clark Fork localities.

Ⓓ and Ⓔ approximate positions of additional Clark Fork localities described by Granger in 1914.

① ② and ③ are areas from which the majority of American Museum Clark Fork fossils were collected.

LITHIC KEY

Q = Quaternary W = Willwood P = Polecat Bench
Precambrian and Paleozoic rocks are exposed at Heart Mountain and in the Beartooth Mountains.

A more precise definition of this fauna was subsequently published by Granger in 1914. Further collecting had increased the number of specimens to fragments "representing nearly 200 individuals" (Granger, 1914, p. 204). Characterized by the absence of perissodactyls, artiodactyls, rodents and primates (the last two not then known from Paleocene deposits), the fauna was composed predominantly of representatives of two genera, *Phenacodus* and *Ectocion,* which constituted over three-fourths of the collection. The rest of the fauna included some Paleocene genera, whose range was known to extend into the overlying Eocene Gray Bull beds, and genera of Gray Bull age. Assignment of the fauna to an appropriate epoch was supposedly aided by the abundant presence of the reptilian genus *Champsosaurus,* which was at the time considered to be a distinctly Cretaceous and Paleocene genus. This evidence, coupled with the absence of the four orders of mammals previously mentioned, inclined Granger to regard these beds as being of late Paleocene rather than early Eocene age.

Because the name "Ralston" was preoccupied by a group of Pennsylvanian rocks, Granger substituted in its place the term "Clark Fork" beds. These sparsely fossiliferous strata were estimated to attain a maximum thickness of 500 feet. Besides the McCulloch Peak locality (A), exposures were prominent "In the bluff [Polecat Bench] in the northern part of the Bighorn Basin" where "characteristic fossils were found as far east as a point north of Powell [i.e. in beds extending northeast from B]." In addition, two new localities were described: "In the Clark Fork basin the fossils were obtained from both sides of the wagon road where it drops down to the Big Sand Coulee from the Bighorn Basin divide, also from . . . the opposite side of Clark Fork River between the mouths of Line and Little Rocky Creeks" (*Ibid.,* p. 204). These last areas, not mentioned in Sinclair and Granger's paper, are marked on the map as localities D and E.

Descriptions of the various new types ascribed to the Clark Fork fauna appeared in a series of papers by Matthew (1915a, b, c; 1918) and Granger (1915), and in one by Simpson (1929). It is interesting to note Simpson's remark (p. 2) that some of the specimens being described might be from the lowest Eocene Sand Coulee horizon rather than from the Clark Fork. However, no reason was given for this statement.

Not until 1930 was a complete faunal list published (Jepsen, 1930b, pp. 492-493), which included several species collected by Princeton University field parties subsequent to the American Museum's initial discoveries. Three new forms were described,

the most significant for this study being *Dipsalodon matthewi,* the only genus restricted to the Clark Fork. In addition, note was made of the fact that *Champsosaurus* could no longer be used to demarcate the upper limit of Paleocene beds, thus invalidating Granger's premise that this genus could be used for distinguishing between Paleocene and Eocene sediments.

Revision of the Clark Fork fauna was undertaken by Simpson (1937). Several forms from the original collection were for the first time described. In addition, one species, *Ambloctonus priscus* Matthew (= *Palaeonictis occidentalis* Osborn; Denison, 1938, p. 175), was removed from the fauna on the grounds that field records associated with the specimen clearly indicated that it belonged with the Sand Coulee fauna. A further deletion from the fauna was made by Jepsen, who removed *Parectypodus,* the only multituberculate that had been regarded as part of the fauna, because its original inclusion had resulted from "an error in locality identification" (Jepsen, 1940, p. 324). No additions or deletions to the fauna have subsequently been published.

INTERPRETATION OF MAPS

Since Granger used only verbal descriptions, rather than section, township, and range data for indicating the locations of specimens and type areas, great value must be attached to the recent finding of his original field map, part of which is reproduced as Figure 2. Its discovery permits much greater confidence in the determination of some of the areas where the original Clark Fork collections were made. No date appears on the map, which was taken from Fisher's 1906 report. Perusal of the field notes, however, indicates that Granger was in this part of the Bighorn Basin only in 1911 and 1912. Therefore, it seems reasonable to infer that the hachures sketched on his map, undoubtedly intended to indicate badlands, correspond to areas prospected in those years. These badlands, consequently, must represent the type localities for the Clark Fork and Sand Coulee beds described by Sinclair and Granger (1912) and Granger (1914). Some of these hachures coincide with the placement of letters B, C, D, and E on Figure 1, thus confirming the positions of most of Granger's type localities. Unfortunately, uncertainty must still remain as to the exact location of the area on the southwest slopes of McCulloch Peak (indicated approximately in Figure 1 by the letter A) because no hachures were drawn on this part of Granger's map.

Confusion may be averted by noting the following problems concerning the same name for different places on various maps.

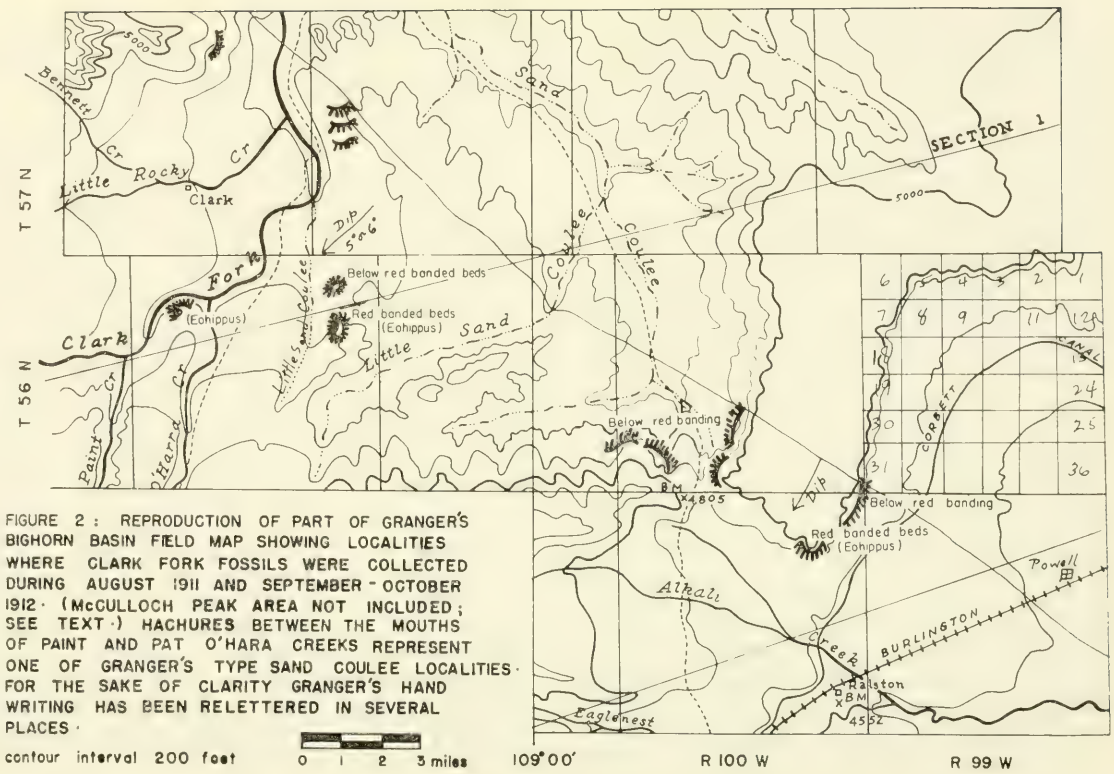

FIGURE 2: REPRODUCTION OF PART OF GRANGER'S BIGHORN BASIN FIELD MAP SHOWING LOCALITIES WHERE CLARK FORK FOSSILS WERE COLLECTED DURING AUGUST 1911 AND SEPTEMBER - OCTOBER 1912. (McCULLOCH PEAK AREA NOT INCLUDED; SEE TEXT.) HACHURES BETWEEN THE MOUTHS OF PAINT AND PAT O'HARA CREEKS REPRESENT ONE OF GRANGER'S TYPE SAND COULEE LOCALITIES. FOR THE SAKE OF CLARITY GRANGER'S HAND WRITING HAS BEEN RELETTERED IN SEVERAL PLACES.

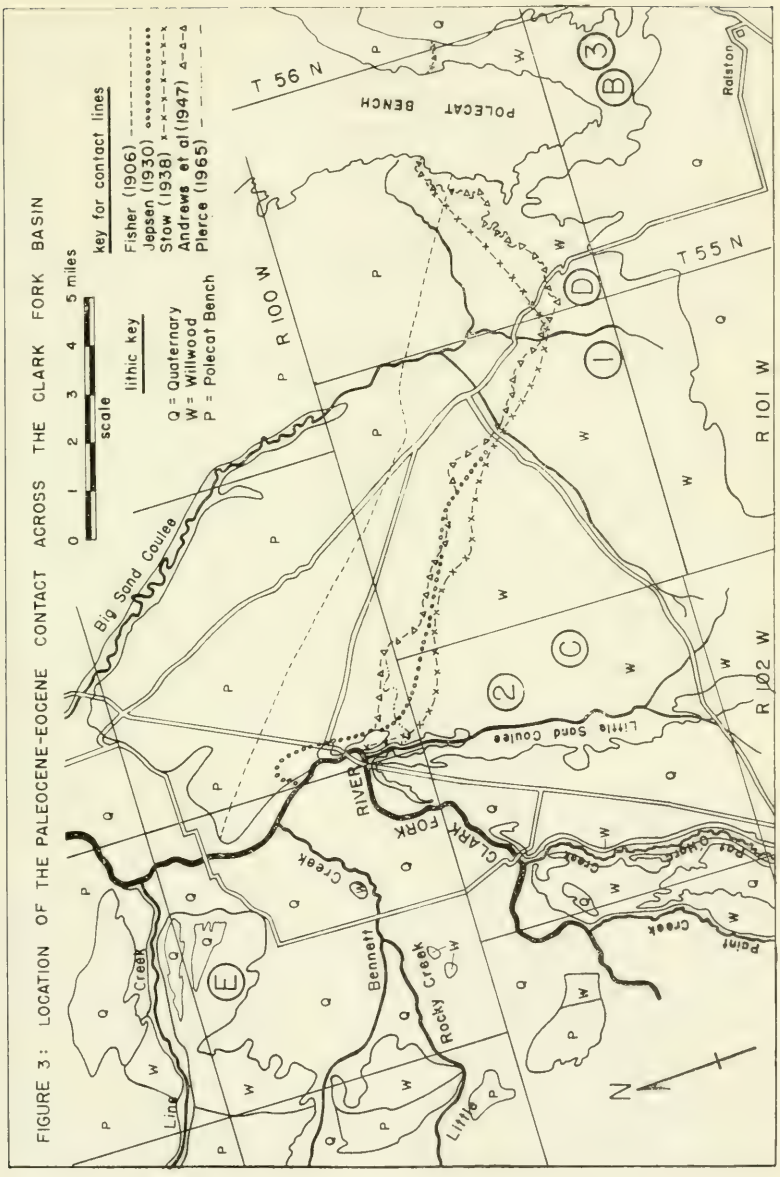

FIGURE 3: LOCATION OF THE PALEOCENE-EOCENE CONTACT ACROSS THE CLARK FORK BASIN

On Fisher's map (1906; see Fig. 2), Bennett Creek is shown as a tributary of Little Rocky Creek. All subsequent maps, however, depict Little Rocky Creek as being a tributary of Bennett Creek (see Fig. 1). Furthermore, Fisher's map indicates Little Sand Coulee as being a branch of Big Sand Coulee, but in the Annual Report of the Department of Vertebrate Paleontology for 1912, Granger remarks that ". . . What is known locally as Little Sand Coulee [is] not the Little Sand Coulee of Fisher's map." The actual location of the coulee is written on Granger's field map (see Fig. 2), and later maps all follow Granger's positioning of the coulee.

A final problem is the question of where the Paleocene-Eocene contact in the Clark Fork Basin is situated. The first geological map of the area was published by Fisher in 1906. Presumably the contact there drawn (refer to Figure 3 for position of this and subsequent contact lines) represented only a rough estimate, as the line across the basin is unnaturally straight, and no discussion of the means by which the contact was detected are included in Fisher's report. Sinclair and Granger (1912) apparently did not take Fisher's contact very seriously, since, with the exception of the McCulloch Peak locality, the beds they describe as having yielded their presumably Paleocene Clarkforkian material are located several miles to the southwest of Fisher's line, well into his Eocene, as can be seen by referring to Granger's field map (Fig. 2). Their 1912 paper, however, includes a sketch map which shows a contact coinciding with that of Fisher's map. In 1930 Jepsen published a map whose Paleocene-Eocene contact lay several miles southwest of and parallel to that recognized by Fisher. The line was drawn more precisely on the basis of paleontological evidence, using the conventional criterion that the lowest Eocene beds are marked by the first appearance of *Hyracotherium*. Agreeing relatively closely with Jepsen's contact is one drawn by Stow (1938) on the basis of the presence or absence of certain types of heavy minerals that he thought permitted differentiation between Paleocene and Eocene sediments. Although apparently unaware of Jepsen's and Stow's works (as their papers are not indicated as being sources of data), Andrews, Pierce, and Eargle (1947) drew a contact closely paralleling these previous ones, but generally slightly to the northeast. For that part of the basin shown on the map, Pierce (1965) indicates minor deviations from his previously drawn contact except in the area directly east of the mouth of Little Sand Coulee, where his boundary diverges appreciably from the earlier one. Thus, the boundary between

Paleocene and Eocene beds has been reasonably clearly established within rather narrow limits. The area where the greatest divergence exists between the various lines, however, is to the east of the mouth of Little Sand Coulee, a fact which is of some importance concerning the provenance of about half the specimens in the Princeton collection (see p. 21).

THE AMERICAN MUSEUM COLLECTION

Data concerning the American Museum's Clark Fork collection are summarized in Table I. One fact readily apparent from this table is that there are only 89 specimens in the original collection, not the "nearly 200" mentioned by Granger. This observation may indicate that many specimens, in addition to the one discussed by Simpson (1937; see above, p. 5), have been at one time or another removed from the fauna without this action having been noted in any publication. On the other hand, it may merely indicate that Granger had overestimated the size of the collection. At any rate, the basis available for defining and characterizing the type collection is less than half as large as published data indicate.

An additional feature worthy of note is the nature of the specimens from the McCulloch Peak area (A, Fig. 1); these are described in Table I, footnote 10. The identifiable fragments include no elements restricted to the Paleocene. This fact lends itself to some interesting speculation, as this locality is the only one of the three originally described by Sinclair and Granger as representing unquestionable Paleocene sediments. In this connection some of Granger's comments in the 1911 Annual Report of the Department of Vertebrate Paleontology are most informative: "These beds [at Ralston] proved to be of the same age as those [from the base of McCulloch Peak] described above and although fossils were scarce some 50 individuals were obtained. The small phenacodonts constituted about ½ the entire number and there still was no trace of Perissodactyla, of Artiodactyla, nor Rodentia. The presence of *Bathyopsis, Limnocyon*, and a *Metacheiromid* were surprising, considering that the beds lie below the Wasatch. . . . The dip of the [Ralston] beds where exposed would carry them below the Wasatch at the base of McCulloch Peak, allowing no fault or change in dip." In other words, Granger apparently considered that the fauna contained in the beds north of Ralston included various forms that he would have expected to find in typical early Eocene sediments. Thus the Clark Fork beds were defined on the basis of negative evidence, i.e., what had not been

TABLE I

THE AMERICAN MUSEUM CLARK FORK COLLECTION

Information taken from field labels associated with the specimens, and also from Denison (1938) and Simpson (1937 and 1943).

SPECIES (Numerals opposite each name indicate the number of specimens from each locality.)	LOCALITIES				
	head of Big Sand Coulee (Locality #1 on map)	east, or three miles east, of mouth of Pat O'Hara Creek (Locality #2 on map)	bluff NE of Ralston; N, or three miles N, of Ralston (Locality #3 on map)	Clark Fork beds, "period," or formation	other
Apheliscus nitidus	1				
Coryphodon sp.	1				1
Didymictis protenus proteus[1]	6		2	6	
Dipsalodon matthewi[2]			1		
Dissacus praenuntius[3]				2	
Ectocion osbornianus ralstonensis	14	4	2		1
Esthonyx[4]					
grangeri	4	1			
latidens	1	1			
cf. *spatularius*			1	1	
not specifically identified	1		1		

Haplomylus speirianus	2		1		
Meniscotherium priscum[7]	1				
Oxyaena aequidens	2			1	1
Oxyaena platypus[6]			1	1	
Palaeanodon parvulus	1				
Palaeoryctes punctatus[7]	1				
Phenacodus primaevus cf. *primaevus*[5] *primaevus* cf. *intermedius*	5	4	4	1	1
Plesiadapis cookei				1	
Plesiadapis dubius			1		
Probathyopsis praecursor[9]	4		1		1
Thryptacodon antiquus		2			
TOTAL[10]	44	12	15	13	5

[1] Fourteen specimens in the Clark Fork collection are labelled as belonging to this subspecies, although Simpson (1937, p. 16) mentions the existence of only five. Six specimens, including the type, are from "Clark Fork beds, head of Big Sand Coulee," a locality within the Gray Bull beds (see p. 14). It is not possible to determine in which beds the other eight specimens were found (pp. 17, 18). Simpson observed (1937, p. 15) that "The Clark Fork specimens are within the range of those from the Gray Bull in every dimension." However, he cites evidence, from measurements of M_2, which he felt required the establishment of a distinct subspecies. Since at least some of the "Clark Fork" specimens are from Gray Bull beds, this distinction between the "Clark Fork" and Gray Bull subspecies would seem to be invalidated, all specimens being referable to the Gray Bull form *D. protenus*.

Footnotes for Table I (continued)

[2]Denison (1938, p. 175) states: "Amer. Mus. No. 16068 from the Clark Fork horizon, described by Matthew . . . as '?*Oxyaena* sp. innom.', is referred here doubtfully to *Dipsalodon*. It includes much worn upper teeth of approximately the same size as *D. matthewi*." Van Valen (1966, p. 82) has referred this specimen to *D. matthewi*.

[3]AMNH No. 18668 has been tentatively referred to this genus, but specific identification is difficult because of the scrappy nature of the specimen.

[4]Simpson (1937) recognizes three, or possibly four, species of *Esthonyx* from the Clark Fork beds: *E. bisulcatus, E. grangeri, E. latidens,* and perhaps *E. spatularius*. AMNH No. 16065 is labelled as "*E.* cf. *spatularius* (type)," but is figured in Simpson (1937, p. 6, fig. 1) as *E. ?bisulcatus*. However, this specimen could not be the type for either species since it was found in 1912, while the two species in question were described by Cope in 1874 and 1880, the type for *E. spatularius* being AMNH No. 4809 and that for *E. bisulcatus* being USNM No. 1103 (Gazin, 1953, pp. 17, 21). None of the specimens in the collection are presently labelled as representing *E. bisulcatus*.

[5]Jepsen (1930b, p. 493) listed this species as being included in the American Museum's collection although Simpson (1937) does not include it in his Clark Fork faunal list. However no mention or reason for its deletion is given. Gazin (1962, p. 67) notes that "the type of *M. priscum* from the Clark Fork beds could not be located in the American Museum collections." Personal investigation has confirmed this report.

[6]Denison (1938, p. 167) referred Matthew's type of *Dipsaladictis platypus* (AMNH No. 15857) to this species, stating that "it is definitely an oxyaenine, which differs from other primitive species of *Oxyaena* only in its smaller size." One additional specimen (AMNH No. 18667) is labelled as belonging to this species.

[7]This specimen (AMNH No. 15850) was listed as "Nyctitheriidae genus and sp. indet." by Simpson (1937, p. 4), but has been described as *Palaeoryctes punctatus* by Van Valen (1966, p. 56).

[8]Many *Phenacodus* specimens are represented as disarticulated bones or miscellaneous tooth and jaw fragments rather than as associated sets of teeth or bones. Individual fossils were labelled variously as *Phenacodus, P. primaevus, P. intermedius,* and *P. hemiconus,* and thus do not concur with the two subspecies included in Simpson's 1937 faunal list.

[9]Only two specimens in the collection are labelled as *Probathyopsis praecursor*. Four other specimens in the collection are labelled *Bathyopsis* or Bathyopsidae. The latter fossils were clearly intended by Simpson to be included in the new genus since one of them comes from opposite the mouth of Little Rocky Creek, one of the localities mentioned as an area where specimens of this species had been found, and it is in fact the only specimen of any kind from this area. For another of the four localities listed

as having yielded *P. praecursor* remains, three miles east of the mouth of Pat O'Hara Creek (locality 2, Fig. 3), no Clark Fork specimens could be located. Simpson suggested (1929, p. 2) that "Some of this material may be from the Sand Coulee horizon." Four specimens, including the type, are from locality 1 (Fig. 3), confirming the idea that at least some of the specimens are part of an early Eocene fauna rather than a late Paleocene Clark Fork one.

[10] In addition to the specimens listed in the chart, the following material is included in the collection: three boxes of "miscellaneous bones and teeth" from the west slope of McCulloch Peak, containing fragments identifiable only as *Champsosaurus, Phenacodus, Ectocion,* and a pantodont; four boxes of miscellaneous fragments labelled only as being from the "Clark Fork Basin," and another from "north of Ralston." None of this fragmentary material would appear to affect the conclusions based on analysis of the better specimens in the collection, and hence has not been discussed.

found in them, rather than on fossils actually contained in them which could be characterized as having a distinctive Paleocene aspect. Since the type fauna was principally found in strata whose position in the section was by no means certain, and since the fauna from the only site regarded by Granger as being definitely of Paleocene age had no obvious Paleocene affinities, it is not at all certain whether or not a Clark Fork fauna can in fact be distinguished.

Examination of the labels accompanying the specimens in the American Museum's Clark Fork collection reveals that over 85 per cent of the fossils, acquired in the years 1910-1916, were found at three sites. These localities were:

(1) the head of Big Sand Coulee (Area D, Fig. 1);

(2) east, or three miles east, of the mouth of Pat O'Hara Creek (Area C, Fig. 1);

(3) north, or three miles north of Ralston; or bluff, or base of bluff, northeast of Ralston (Area B, Fig. 1).

For convenience of reference, American Museum specimens from these areas will henceforth be designated merely as being from locality number 1, 2, or 3 (see Fig. 1).

Locality number 1 is in the region characterized by Granger as the type area of the lowest Eocene Sand Coulee beds (1914, p. 205). "Near the head of Big Sand Coulee in the Clark Fork basin there is a series of about 200 feet of red-banded shales lying

between the gray shales[1] of the Clark Fork and the *Systemodon*-bearing gray shales above which are referred to the Gray Bull beds. The outcrop of these red-banded beds extended, from the high bluff on the south side of the Coulee, in a northwesterly direction across the basin for several miles." Furthermore, in this same paper, Granger describes (p. 203) the Gray Bull beds and mentions various areas where they outcrop. "In the Clark Fork basin they are exposed in the southwestern part along the heads of Big and Little Sand Coulees, where they are of a uniform gray color instead of the usual gray, red, and yellowish banding." Reference to all the geologic maps of this part of the basin shows that the Paleocene-Eocene contact line crosses the southern branch of Big Sand Coulee approximately two miles below its head, and the western branch nearly five miles from its head. The eastern prong of the coulee, of which the one on the map is only one of many, is probably not that referred to on the labels, since its head originates at the base of Polecat Bench and such a fact would have made a convenient reference for the labels. As Granger noted the misidentification of Little Sand Coulee on his field map (refer to p. 8 and Fig. 2), he may have been talking about either the southern or western branches of Big Sand Coulee. However, whichever of these two is chosen, the locality would be well into Eocene Gray Bull or Sand Coulee strata. In view of the fact that Granger's field map indicates an extensive area of prospected exposures at the head of the southern branch of Big Sand Coulee, and none are marked near the head of its western fork, it is most probable that this area is the one in question. There is no doubt at present that these are Gray Bull beds.

In addition, many specimens in the American Museum collections labelled as "Wasatch," "Sand Coulee," or "Gray Bull" are noted also as having come from "the head of Big Sand Coulee." For example, the label accompanying the type of *Apheliscus nitidus* (AMNH No. 15849, listed in Table I) reads "Clark Fork formation, Clark Fork, Wyoming, 1911, head of Big Sand Coulee." That accompanying another specimen of the species, AMNH No. 16925, reads "Wasatch formation, Sand Coulee Beds, Clark Fork,

[1] Jepsen has pointed out that it is impossible to use color banding for distinguishing Clark Fork from overlying beds, since ". . . red strata occur well down in the Clark Fork beds" (1940, p. 237; see also 1930b, p. 493).

Wyoming, 1913, head of Big Sand Coulee." All other specimens of *A. nitidus* are similarly labelled as being from Gray Bull beds. It would therefore appear that the two cited specimens, although labelled as being from two different horizons, are most probably from the same one, the Gray Bull. Consequently, based on the evidence revealed by the specimen labels, it is probable that all supposed Clark Fork fossils labelled as having been found at the "head of Big Sand Coulee" should more properly be referred to the lower Gray Bull or Sand Coulee beds. Since half of Sinclair and Granger's original Clark Fork fauna (see Table I) was obtained from the vicinity of the head of the Coulee, it is likely that these specimens are part of one or more early Eocene faunas rather than of a late Paleocene Clark Fork fauna.

"East [or three miles east] of the mouth of Pat O'Hara Creek" (locality 2) is an area lying in an extensive series of Willwood exposures. This locality, as is true for locality 1 also, was never mentioned by Granger as one of the five type areas (A through E, Fig. 1) for the Clark Fork beds. Granger's field map (Fig. 2) shows two sets of badlands sketched along a north-south axis in this region, the southern one being labelled "red-banded beds" and the northern one "below red-banded beds." These may be interpreted in the light of Granger's remarks in the 1913 Annual Report of the Department of Vertebrate Paleontology: "Section across Clark Fork Basin from head of Little Sand Coulee northeast to mouth of Big Sand Coulee:

Wasatch — gray shales — 500+ feet
[Sand Coulee] — red-banded shales — 200 feet
Ralston — gray shales — 500+ feet."

Clearly, the red-banded beds must represent some of Granger's Sand Coulee exposures. Consequently, the beds farther north can only be regarded as Clark Fork beds, and it seems reasonable to assume that locality 2 corresponds to this area, which has always been mapped as being covered by Eocene beds (Fig. 3). It seems curious that part of a fauna purported to be of latest Paleocene age should be derived from sediments whose presumed early Eocene age has never been questioned. With respect to this paradox, an examination of the specimens from locality 2 is most instructive. Reference to Table II reveals that all of the Clark Fork fossils from locality 2 are also known from the Sand Coulee or Gray Bull, and often from both of these horizons. In fact, the one specimen of *Phenacodus hemiconus* from this locality was apparently regarded by Granger as being of Gray Bull provenance,

TABLE II

SPECIMENS IN THE AMERICAN MUSEUM CLARK FORK COLLECTION FROM LOCALITY 2

SPECIES (Identifications are taken from the labels associated with the fossils)	REFERRED SPECIMENS (AMNH)	HORIZONS IN THE CLARK FORK BASIN FROM WHICH THE SPECIES IS KNOWN
Ectocion ?osbornianus	16047	Clark Fork, Sand Coulee, Gray Bull (Granger, 1915, p. 352)
Ectocion ralstonensis	16046, 16061	Clark Fork, Sand Coulee, Gray Bull (Granger, 1915, p. 353)
Ectocion	1 unnumbered	Not specifically identified; thus nothing can be said about its range.
Esthonyx grangeri	39597	Clark Fork, Sand Coulee (Simpson, 1937, p. 9)
Esthonyx latidens	16066	Clark Fork, Sand Coulee (Simpson, 1937, p. 10)
Phenacodus hemiconus	16056	Gray Bull (Granger, 1915, p. 339)
Phenacodus primaevus	16054, 16059. 1 unnumbered	Clark Fork, Sand Coulee, Gray Bull (Granger, 1915), p. 354)
Thryptacodon antiquus	16075, 16076	Clark Fork, Sand Coulee, Gray Bull (Matthew, 1915a, p. 8)

as he states (1915, p. 339): "Eleven specimens from the Gray Bull beds and one from the Lost Cabin are referable to this small variety." Thus there is nothing distinctive about the specimens from this locality to suggest their association with the Clark Fork fauna; on the contrary, based on the presence of *Phenacodus hemiconus,* there is a slight suggestion that these specimens may actually be of Gray Bull derivation. At any rate, since this area was not described as one of Granger's type localities, and since its faunule does not differ significantly from those of other Sand Coulee or lower Gray Bull sites, it seems highly probable that "east" or "three miles east of Pat O'Hara Creek" is in Sand Coulee or lower Gray Bull, and not Clark Fork, strata.

Specimens from locality 3 are too vaguely labelled to be of any value in this study. Faunas from the southeastern side of Polecat Bench have been found ranging from the Silver Coulee through the lower Gray Bull. Without knowledge of section, township, and range, it is virtually impossible to infer to what fauna these American Museum fossils belong. It is very likely that elements from several faunas are actually represented by these fossils. Therefore, on the basis of the foregoing inferences, none of the American Museum materials from localities 1, 2, or 3 can certainly be ascribed to what have been regarded as Clarkforkian strata. Rather, those from localities 1 and 2 can be considered as pertaining in all probability to one or more early Eocene faunas, while specimens from locality 3 cannot be definitely assigned either to a late Paleocene or to an early Eocene fauna.

No specimens in the collection are labelled as having come from either side of the wagon road dropping into Sand Coulee Basin (area D on map). However, any such specimens would definitely be of early Eocene age.

Listed in Table I is another group of specimens that may be considered as a unit for the purposes of this review. In contrast to the previous three groups discussed, which were characterized by similarities in locality data, this fourth group is distinguished by a total lack of useful locality information. Labelled variously as coming from "Clark Fork beds" or "formation," or even "Clark Fork Period," these fossils clearly can be of no use in defining the composition of the fauna for the following reasons. First, as has already been shown, if these fossils came from localities 1, 2, or 3, they probably should not be included in the Clark Fork fauna. Second, if these specimens were not found at localities 1, 2, or 3, then they could have been picked up anywhere by

chance in a basin where four faunal horizons (Silver Coulee, Clark Fork, Sand Coulee, and Gray Bull) have been described, as the labels associated with these specimens give no guidance as to the specific area in which they were collected.

The five remaining specimens from the type collection, not excluded from being Clarkforkian by virtue of the considerations already discussed, are listed in Table I under the column headed "other." Of the fossils in this category, only two specimens, one of *Coryphodon* sp., and one of *Ectocion osbornianus ralstonensis*, were found at one of Granger's type areas, "between Little Rocky and Line Creeks," marked as locality E on the map. The hachures in section 3, T 57 N, R 102 W of Granger's field map probably represent the exposures in which these specimens were collected. Andrews, Pierce, and Eargle (1947) showed both Paleocene and Eocene sediments in this region. However, Pierce (1965) indicates that only Eocene and Quaternary deposits are found within this section. Very probably, therefore, the two specimens under consideration should be associated with the Sand Coulee or Gray Bull faunas.

Also in this last category is one specimen of *Phenacodus primaevus* that was found "6 miles north and one mile east of Powell, Wyoming, at base of bluff," unquestionably an area of Paleocene deposits. This specimen may be regarded as coming from the Polecat Bench Formation.

Accompanying a single specimen of *Probathyopsis praecursor* (AMNH 16063) are the following locality data: "southeast side of Clark's Fork, opposite mouth of Little Rocky Creek, Ralston [Clark Fork] formation." The most recent maps show Little Rocky Creek as being a tributary of Bennett Creek, and the sediments opposite its mouth, on the west side of the Clarks (or Clark) Fork River are mapped as Quaternary in age. However, Fisher's map shows Bennett Creek as being a tributary of Little Rocky Creek (see p. 8), and the rocks opposite the latter creek's mouth on the east bank of the Clarks Fork River were mapped as being of Eocene age. Therefore, it would seem that the locality designated by the label refers to the area opposite the mouth of Bennett Creek as its course is presently mapped. Hachures in this vicinity on Granger's field map (Fig. 2) would appear to confirm this deduction. Excluding the Quaternary deposits immediately to the east of the Clarks Fork channel, Jepsen (1930b), Stow (1938), Andrews, Pierce, and Eargle (1947), and Pierce (1965) have all regarded the sediments of this area as being of Paleocene age. In this review, therefore, this one specimen of *Probathyopsis* will be regarded as being from upper Paleocene beds.

In the case of the only fossil not yet discussed, the locality data are relatively specific. The type of *Oxyaena aequidens* is from "Clark Fork beds, Clark Fork Basin, 1912, about seven miles east of Pat O'Hara Creek." Rocks in this part of the Clark Fork Basin are extremely flat-lying, and it is rather difficult to establish the contact between the conformable Paleocene and Eocene strata, as can be seen from the fact that the contact lines drawn by different mappers differ markedly one from another (see Fig. 3). The *Oxyaena* specimen was probably found somewhere in this contact region. However, considering both the fact that the distance estimate made in 1912 could have been at best only an approximation, and that there is no agreement as to exactly where the contact lies in this region anyway, it can only be a matter of speculation as to whether this specimen belongs to a late Paleocene or an early Eocene fauna. Thus, the specimen is of no help in defining the Clark Fork fauna.

Of the original Clark Fork collection of 89 specimens, therefore, only two, one of *Phenacodus primaevus* and one of *Probathyopsis praecursor,* may be certainly regarded as being from the Polecat Bench Formation. The remainder of the specimens must be excluded from this category for one of two reasons. Either the fossils are of a different age from what they were originally considered to be, or the locality data associated with the specimens are not specific enough to be of any stratigraphic utility. As it would be unwarranted to try to define a fauna on the basis of only two species, each represented by only one specimen, it is necessary to analyze other evidence pertaining to this problem.

THE PRINCETON UNIVERSITY COLLECTION

Comparison of Tables I and III reveals several marked differences between the Princeton and the American Museum Clark Fork collections. First, there are only about one-fifth as many specimens in the Princeton collection as in that of the American Museum. Second, there are somewhat better documented locality data for the Princeton material. Still another contrasting factor is that the preponderance of the American Museum specimens was collected during the two field seasons of 1910 and 1911, while Princeton parties have been adding to the collection continuously for over 30 years. Only genera added to Clark Fork fauna by Jepsen in 1930 (with the exception of *Parectypodus,* see above, p. 5) will be considered in the present review, as these elements are the ones that have formed part of the basis on which the fauna has usually been defined.

TABLE III

SPECIMENS UPON WHICH PUBLISHED REPORTS OF THE PRINCETON CLARK FORK COLLECTION HAVE BEEN BASED.[1]

SPECIES	PU No.	LOCALITY DATA ASSOCIATED WITH SPECIMEN
Carpolestes dubius	13284	near mouth of Little Sand Coulee
	14853	S 12, T 54 N, R 96 W (Foster's Gulch)
Coryphodon proterus	13400	3 miles SW of Bear Creek, Carbon Co., Montana
Dipsalodon matthewi	13152	(type) S 14, T 56 N, R 101 W
	13311	east of mouth of Little Sand Coulee
Dissacus praenuntius	13295	east of mouth of Little Sand Coulee
	13309	east of mouth of Little Sand Coulee
Ectocion osbornianus ralstonensis[2]	13216	1 mile SW camp 3, 1928 expedition
	13310	east of mouth of Little Sand Coulee
	13312	east of mouth of Little Sand Coulee
	14872	S 12, T 54 N, R 96 W (Foster's Gulch)
Esthonyx sp.	13324	east of mouth of Little Sand Coulee
Phenacodus primaevus	13318	approx. 1 mile above mouth of Little Sand Coulee
	14994	S 8, T 56 N, R 99 W
Plesiadapis cookei	13293	(type) S 32, T 57 N, R 101 W
	13307	east of mouth of Little Sand Coulee
	13308	east of mouth of Little Sand Coulee
Probathyopsis sp.	13378	east of Little Sand Coulee near its mouth (same general area as No. 13293, *Plesiadapis*)
TOTAL NUMBER OF SPECIMENS:	18	

[1] Specific identifications are taken from Jepsen (1930b), and Simons (1960), and were checked against the labels in the Princeton University collection in 1962.

[2] Jepsen (1930b, p. 493) identified the specimens in the Princeton collection as *Ectocion ralstonensis*. The terminology used here has been altered to agree with Simpson's re-evaluation of the genus (1937, pp. 19-22; 1943, pp. 174-176).

Over one-half of the specimens in the Princeton collection were found in an area designated on the labels as "east of [or near] the mouth of Little Sand Coulee" (see Table III). How restricted an area this description represents is a moot point since the topography of this region offers few outstanding features to serve as convenient reference points and, as noted in the previous section, various mappers have differed in their opinions of exactly where the contact between the Paleocene and Eocene should be drawn in this region. Consequently, these fossils may represent strictly Paleocene forms, strictly Eocene forms, or some of both ages. In this case, not only a lack of accurate locality data, but also a lack of agreement as to where the contact is, hinder any useful evaluation of this part of the collection with respect to defining the Clark Fork fauna. The remainder of the specimens in the Princeton collection represent isolated finds scattered across a broad region. Nearly fifty miles separate the farthest spaced of the specimens attributed to the Clark Fork.

Representatives of two species, *Ectocion osbornianus ralstonensis* and *Phenacodus primaevus,* comprise roughly one-third of the Princeton Clark Fork collection. Both of these species are found in overlying faunal horizons. In addition, the presence of *Phenacodus* sp. and *Ectocion* sp. has been reported from the Silver Coulee faunal horizon immediately below the Clark Fork beds (Jepsen, 1930b, p. 491). Reference of most of the American Museum specimens, previously regarded as being of Clarkforkian age, to one or more of the early Eocene faunas was shown in the previous section to be virtually certain. Some aspects of the phylogeny of these species, originally reconstructed from studies of American Museum materials, have thus been deduced on the basis of erroneous stratigraphic assumptions. Restudy is required before they can be used in the definition of any fauna. Consequently, specimens of *Phenacodus* and *Ectocion* are at present of no value in helping to define a characteristic Clark Fork fauna.

The specimen originally designated as *Coryphodon* (species undetermined) by Jepsen (1930b, p. 493) has been described by Simons (1960, p. 13) as *Coryphodon proterus.* Only the type can be assuredly ascribed to this species. Definite inclusion of this specimen in the Clark Fork fauna is not possible. It was found at the foot of the Beartooth Mountains where unconformities between Tertiary and Paleozoic rocks prevent accurate determination of stratigraphic position. No other fossils were found associated with *Coryphodon proterus,* so that no faunal clues are available to help make stratigraphic inferences. In fact, the only

reason for referring this specimen to a Paleocene horizon is that it was found in rocks mapped, presumably on non-paleontological grounds, as being of Paleocene age. Whether *C. proterus* is of Paleocene or Eocene age cannot be determined on the basis of available evidence.

Similarly, the one specimen of *Esthonyx* sp. known from the Princeton collection must be excluded from further consideration as an element of the Clark Fork fauna, since it is impossible to determine whether the specimen came from Paleocene or Eocene beds (see Table III, text p. 21). However, since all the American Museum Clarkforkian representatives of this genus have been shown to be most probably of Lower Eocene derivation, it seems reasonable to assume, contrary evidence being lacking, that the Princeton *Esthonyx* is likely to be of the same age.

A single specimen recovered from the sediments "east of the mouth of Little Sand Coulee" was identified by Jepsen (1930b, p. 493) as *Probathyopsis* sp. Since its stratigraphic position remains in question (see above p. 21), it is unsuitable in helping to define any fauna. For the same reason, the two specimens of *Dissacus praenuntius* listed in Table III can not be used to distinguish between different faunal horizons.

The specimens of *Carpolestes dubius* attributed to the Clark Fork horizon have been recovered from two widely spaced localities. Although the age of the rocks at one of these localities is problematical, the other site is undoubtedly of Paleocene age. However, *Carpolestes dubius* is known from horizons both above and below the Clark Fork level (Jepsen, 1930b, p. 491; Van Houten, 1945, p. 450), the type being from the Silver Coulee faunal horizon. Thus this species is so wide-ranging through time that its presence is of no use as an indication of Clarkforkian age.

There is no reason to question that the type specimen of *Dipsalodon matthewi* was found in late Paleocene sediments. Unfortunately, the only other specimen was collected in the problematical region "east of the mouth of Little Sand Coulee." However, Patterson (personal communication) informs me that a specimen of *?Dipsalodon* sp. is present in the Plateau Valley fauna of Tiffanian age. Patterson's specimen (FMNH No. P26095) is a fragment of the right maxilla with P^4, the broken stump of M^1, and the root of M^2. It can be compared with AMNH No. 16068, consisting of P^4 and M^1, which Denison (1938, p. 175) has doubtfully referred to *D. matthewi*. (This specimen is listed as an oxyaenid in Table I.) But since Jepsen's two specimens of *D.*

matthewi are both represented by lower teeth only, no direct comparison can be made between them and Patterson's specimen. (PU No. 13152 (type) has $P_{1\ 4}$, $M_{1\ 2}$; PU No. 13311 is an M_1.) Patterson's manuscript notes state that his "specimen is smaller than the type of *D. matthewi* and AMNH No. 16068. It probably represents a new species." In spite of not being able to make direct comparisons between Patterson's and Jepsen's specimens, however, it is possible to say that they are roughly of the same size and morphology, as might be expected in forms related at the generic level. Consequently, *Dipsalodon* can no longer be regarded as the only genus restricted to the Clark Fork fauna.

Precise locality data are associated with only one of the supposedly Clarkforkian representatives of *Plesiadapis cookei* (Table III). But this specimen, the type, was found in the region east of the mouth of Little Sand Coulee where disagreements exist concerning the location of the contact between Paleocene and Eocene sediments. The specimen's uncertain stratigraphic derivation precludes its being clearly assigned either a Paleocene or an Eocene age. The two other specimens of *P. cookei* were also found in the same general area, and the same uncertainty applies to them. Thus, on the basis of published evidence it is not possible to include *P. cookei* definitely in the Clark Fork fauna.

As already stated, over half of the Princeton collection must be eliminated from consideration as elements of the Clark Fork fauna solely on the basis of insufficiently precise locality data. Because of wide-ranging stratigraphic distribution and a lack of reliable knowledge regarding phyletic relationships, other specimens are similarly not suitable for defining the fauna. Only two described specimens in the Princeton collection, the type of *Dipsalodon matthewi* and one of *Carpolestes dubius,* may still be considered as having certainly come from the latest Paleocene strata in this area. Together with one specimen of *Phenacodus primaevus* and one of *Probathyopsis praecursor* in the American Museum collection, these fossils represent the only certain components of what has been described as the Clark Fork fauna. As previously mentioned, however, *Phenacodus* is at present of no use for fine age discriminations between rocks in the mid-Paleocene to early Eocene time span. The single specimen of *Probathyopsis praecursor* can hardly be diagnostic of a latest Paleocene faunal assemblage when all the other described specimens of this species are probably of early Eocene age. *Carpolestes dubius* is already known to range from Silver Coulee to Gray Bull. Since nothing

is known about the rates of deposition of the Polecat Bench sediments, it is possible that the "Clark Fork" specimens of *Phenacodus primaevus, Dipsalodon matthewi, Carpolestes dubius* and *Probathyopsis praecursor* may be either essentially contemporaneous with or of a younger age than the fossils in the Silver Coulee fauna. But until a larger number of fossils from the latest Paleocene sediments are found, it is not possible in practice to differentiate a Clark Fork fauna from those of under- and overlying strata. At any rate, to base one of the provincial ages in the standard section of the North American Continental Tertiary on a "fauna" consisting of only four specimens representing four species seems unwarranted. As a direct consequence there also do not seem to be sufficient grounds for continuing to regard the Clark Fork as a discrete uppermost Paleocene faunal zone or as a member of the Polecat Bench Formation.[1]

SOME RELATED PROBLEMS

If it is accepted that a definitive Clark Fork fauna is not a reality, then a number of questions arise. For example, most of the American Museum material of *Probathyopsis praecursor,* including the type, clearly is from lower Gray Bull beds. In addition, there is no certainty as to whether the one specimen of *Probathyopsis* sp. was found in Paleocene or Eocene deposits. These facts complicate the evolutionary sequence proposed by Jepsen (1930a, p. 129) of (1) *P.* sp., (2) *P. praecursor,* and (3) *P. successor.* The evidence strongly suggests that *P. praecursor* and *P. successor* actually existed contemporaneously rather than that the former gave rise to the latter. Furthermore, it is entirely possible that *P.* sp. might also have coexisted with the other two forms. Wheeler (1961, p. 21) states that *P. newbilli* from the Plateau Valley beds "is quite distinct from both *P. praecursor* and *P. successor* and is not closer to one than to the other." Such a statement suggests that *P. newbilli* could be ancestral to the two later, divergent forms. However, this scheme would not clarify the relationship of *P.* sp. to the other forms with which it may have been contemporaneous. Jepsen (1930a, p. 129) felt that *P.*

[1] The possibility of course exists that a post-Tiffanian Paleocene provincial age may be recognized in the future. In that event the age would require a new name. "Clarkforkian" could be resurrected only if a real fauna of such age were to be found in the Clark Fork area. In view of the intensive search for one that has been made there over the past thirty-five years I regard this possibility as most unlikely.

sp. is more similar to *P. praecursor* than to *P. successor,* but until there is better stratigraphic control it will be difficult to resolve the problem of *Probathyopsis* taxonomy.

The classification of *Ectocion* has received attention from Granger, Simpson, and McKenna. From the material available to him, Granger (1915, pp. 348-354) described four species: *E. parvus, E. ralstonensis, E. osbornianus,* and *E. superstes.* Simpson (1937, pp. 19-22; 1943, pp. 174-176), however, felt that Granger's four species should be regarded as successive subspecies grouped under the specific name *E. osbornianus.* More recently, McKenna (1960, pp. 102-103) discussed *Ectocion* classification in his paper on the Four Mile fauna. His remark (p. 103) that "the locality data of practically all existing collections of Willwood mammals are inadequate for detailed stratigraphic (and hence evolutionary) analysis" is equally applicable to specimens attributed to the Clark Fork fauna. But neither Simpson's nor McKenna's proposed classification is clearly acceptable because of the probability that most of the American Museum's Clarkforkian specimens are of Eocene rather than Paleocene age. *E. osbornianus ralstonensis,* for example, presumably existed contemporaneously with *E. o. complens,* formerly thought to be the evolutionary successor of this species.

Restudy of early representatives of the genus *Phenacodus* will also be required. Two species, *P. primaevus* and *P. intermedius,* whose ranges were listed as extending down into Clark Fork beds, were described by Granger (1915, pp. 337, 342). Subsequently Jepsen (1930b, p. 491) reported the presence of *P.* sp. in his Silver Coulee fauna. *Phenacodus primaevus grangeri* is also known from the Plateau Valley fauna (Patterson, personal communication). Simpson (1937, pp. 17-19) published a statistical analysis of the lower Gray Bull and Clark Fork phenacodonts in the American Museum collection. He thought that possibly the Clark Fork and some of the Gray Bull specimens represented a single species. Further, he felt that perhaps the two groups might be differentiated on a subspecific level, concluding (p. 19) "that the Clark Fork specimens are a nearly or quite homogeneous sample of one subspecies and that this subspecies may also occur in the Gray Bull . . . or may be distinct. These alternatives cannot at present be adequately checked." In view of the probability that most of the supposed Clarkforkian phenacodonts were actually found in Gray Bull beds, it would not be surprising if the two samples represented only one species.

Conceivably the type and only known specimen of *Plesiadapis dubius* (AMNH No. 16073) could have come from either late Paleocene or early Eocene strata, having been found at locality

number 3. In appearance it most closely resembles *P. fodinatus,* originally described (Jepsen, 1930b, p. 515) from the late Paleocene Silver Coulee horizon. The character separating these two species was noted by Jepsen as follows: "The anterior crest of P_4 is developed into a minute cuspule, and a small ridge appears on the anterolingual part of the protoconid, quite in contrast to the distinct metaconid on P_4 of *P. dubius.*" Unfortunately, P_4 of the type of *P. fodinatus* (PU No. 13278) has been broken off and is now missing, so that it is no longer possible to make the comparison except from Jepsen's illustrations. The abundant quarry material of *P. fodinatus,* most of which has been obtained since 1930, reveals, however, that the presence or absence of a distinct metaconid is a variable feature and not a specific character. That only one specimen of *P. dubius* has ever been found seems curious, in view of the rather extensive amount of field work in the upper Paleocene and lower Eocene beds of this region. Since the range of *P. fodinatus* has been, subsequent to 1930, extended up into the lower Gray Bull by continued collecting, it appears entirely possible that *P. fodinatus* is a synonym of *P. dubius.*

The Sand Coulee beds were defined by Granger (1914, p. 205) as follows: "This horizon does not contain *Systemodon* but it does contain the Perissodactyl genus *Eohippus* in abundance as well as Artiodactyls, Rodents, and Primates, and marks the first appearance of these four orders. It also marks the last appearance of the primitive order Multituberculata which is represented in this horizon by a genus of Plagiaulacids." Many of the criteria used to characterize this faunal zone have in the past fifty years been shown not to be definitive. Rodents and primates were later found in the Paleocene. Granger's "plagiaulacids," now classified as ptilodonts, are known from levels higher than the Sand Coulee.[1] When *Homogalax* (*Systemodon*) was found in the Sand Coulee beds subsequent to Granger's definition of them, Jepsen (1930a, p. 119) suggested suppression of this term and included the beds

[1] However, multituberculates are very rare in Gray Bull and later deposits. Van Houten (1945, p. 448) reports one species, *Ectypodus simpsoni,* extending into middle Gray Bull beds. Robinson, Black, and Dawson (1964, p. 810) have described a multituberculate from upper Eocene deposits near Badwater, Wyoming. However, their specimens, representing "an undescribed species related to *Ectypodus hazeni,* . . . comprise a small percentage of the fauna, certainly less than 1 percent . . ." These two cases are the only known occurrences of multituberculates above the Sand Coulee strata.

in the Gray Bull. Simpson (1937, p. 1), however, noted that "the Sand Coulee fauna was not wholly defined . . . on the absence of *Homogalax* but also by the generally slightly less advanced character of its mammals." Now that most of the American Museum's Clarkforkian material can be probably relegated to lower Eocene beds, it may be possible to redefine a Sand Coulee fauna. For example, this might be done on the basis of the presence of *Plesiadapis cookei* and a species of *Probathyopsis,* the last abundant appearance of the multituberculates, and a more primitive aspect in those forms common to both the Sand Coulee and Gray Bull. Reappraisal of the Sand Coulee fauna is desirable in order to determine conclusively whether or not such a horizon can be distinguished.

SUMMARY

Some of the published data concerning the American Museum's Clark Fork collection do not agree with the locality information on specimen labels. For example, there are no fossils from either side of the road descending into the Sand Coulee Basin from the Bighorn Basin divide (area D), although it was described as one of the Clarkforkian type localities. The majority of the American Museum collection comes from three localities (1, 2, and 3, Fig. 3). Review shows that it is doubtful that most of these specimens from localities 1 and 2 should be referred to a late Paleocene Clark Fork horizon, but that they are rather of early Eocene age. Other specimens (those from locality 3 or labelled as being from Clark Fork "beds," "period," or "formation") are associated with such vague stratigraphic information that it is not possible to determine whether they are from upper Paleocene or lower Eocene beds. Because of insufficient locality data it is also impossible to say whether or not approximately one-half of the described Princeton collection belongs to a late Paleocene or an early Eocene fauna. A wide ranging stratigraphic distribution or a lack of adequate knowledge regarding phylogenetic relationships precludes using most of the remaining fossils to characterize the fauna.

Thus, of 107 specimens (representing at least 23 and perhaps 26 species) in both the American Museum and Princeton collections that have been described as elements of the Clark Fork fauna, a total of only four specimens representing four species (*Carpolestes dubius, Phenacodus primaevus, Probathyopsis praecursor,* and *Dipsalodon matthewi*) can be surely ascribed to a possible latest Paleocene faunal horizon in the Polecat Bench Formation. However, only one of these species (*Dipsalodon*

matthewi) may be unique to what has been described as the Clark Fork fauna. *Carpolestes dubius* is known from both the Silver Coulee and the Gray Bull. Specimens of *Phenacodus primaevus* are known from the Gray Bull, and *Phenacodus* sp. is present in the Silver Coulee. Until the phylogeny of this genus is reviewed, it is not possible to use species of *Phenacodus* for horizon markers. *Probathyopsis praecursor* is much more commonly found in early Eocene than late Paleocene beds. Thus this species can hardly be considered as diagnostic of the Clark Fork fauna. If *?Dipsalodon* sp. from the Tiffanian Plateau Valley deposits of Colorado is correctly referable to this genus, then it invalidates the supposed restriction of this genus to the Clark Fork.

Therefore, the Clark Fork "fauna" consists of four specimens referable to four mammalian genera, each from a different locality. None of the genera (and not more than one of the species) are restricted to a lithically distinguishable Clark Fork horizon. Such evidence scarcely warrants recognition of the Clark Fork as a provincial age, faunal zone, or member of the Polecat Bench Formation.

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